

Heated High Flow Nasal Cannula Use at the Hospital for Sick Children

A Retrospective Chart Review

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Background

Heated high flow nasal cannula (HHFNC) therapy is a non-invasive ventilation support system that delivers high concentrations and flow rates of oxygen (>2 litres per min).^{1,2} The higher amount of flow compared to traditional nasal cannula therapy helps to stabilize the fraction of inspired oxygen (FiO₂) and minimize the amount of trapped room air by flushing out nasopharyngeal dead space.^{1,2,3} This allows a more accurate assessment of a patient's oxygen needs.¹ Since the oxygen is heated and humidified, the higher flow rate can be tolerated; also reducing the potential for mucosal dryness and nasal trauma compared to traditional oxygen therapy.^{1,2,4}

At the Hospital for Sick Children (SickKids) HHFNC therapy focuses on four main indications: a) the management of tenacious secretions via the provision of humidified air; b) to treat hypoxemia; c) to alleviate increased work of breathing; and c) to assist in the facilitation of extubation from invasive supports and/or weaning from non-invasive ventilation.⁶ While HHFNC has been appraised in the adult population, the assessment of the tolerance, indication, and success of HHFNC therapy in the paediatric population is lacking.

Objectives

1. Describe the use of HHFNC at SickKids for patients in the critical care unit (CCU), emergency department (ED) and wards.
2. Determine predictors of HHFNC therapy failure.

Methods

Three health record systems were used to extract variables for quantitative analysis from patients using HHFNC since its inception in 2013 and admitted to the CCU, ED and/or wards at SickKids. Patients from the neonatal intensive care unit and/or treated via tracheostomy/face mask were excluded.

Outcomes

- **Demographic:** age, weight, gender, diagnosis/comorbidities, & length of stay (LOS)
- **HHFNC therapy:** indication for therapy, flow rate, FiO₂, temperature, duration of therapy
- **Clinical variables:** work of breathing, breath sounds, and chest activity, vital signs (respiratory rate, heart rate, oxygen saturation [SpO₂]), blood gases (arterial, venous, capillary and mixed venous)

Responders and Non-Responders: Non-response was defined as a) patient intolerance/agitation; b) transition to non-invasive/invasive mechanical ventilation; c) transfer to the CCU; d) cardiac arrest; and/or e) death. Responders were all others who were successfully treated on HHFNC

Analysis: outcome characteristics via descriptive statistics. Variables between responders and non-responders will be compared using chi-square, two-sample t-test or Wilcoxon rank sums tests (depending on data). A multiple logistic regression model will be used to determine which variables predict non-response to therapy. A p>0.05 is considered significant.

Preliminary Results

Table 1: characteristics of patients and HHFNC

Variable	Mean (SD; range)
Age (weeks) N=106	5.0 (4.7; 1-32)
Age (months) N=204	7.0 (6.1; 1-42)
Age (years) N=149	4.4 (3.9; 1-17)
LOS (days) in unit where HHFNC initiated, N=463	19.6 (32.0; 1-190)
LOS (days) in hospital, N=457	61.8 (73.9; 1-456)
Baseline flowrate (lpm), N=457	12.1 (8.3; <1-60)
Baseline FiO ₂	0.45 (0.71; 0.21-1.0)
Duration of therapy (days), N=460	60.2 (79.5; 0.5-554)

N=452 patients met eligibility criteria (data extraction completed Aug 15, 2016). We are currently cleaning the data for full analysis thus the results (Table 1 and 2) are preliminary descriptive analyses only. N=64 (14%) had more than one instance of HHFNC therapy. Results include all instances of HHFNC. Adverse effects were only reported for a few patients: n=21 died (not known if due to HHFNC), n=3 had nasal trauma and n=2 a nosocomial infection.

Table 2: characteristics of patients and HHFNC

Variable	N (%)
Male	261 (55)
Reason for admission into unit	
1. Respiratory	222 (47)
2. Cardiac surgery	155 (33)
Location where HHFNC started	404 (85)
1. CCU	36 (7.6)
2. Wards & ED	
Indications for HHFNC	
1. Post extubation or weaning from non-invasive ventilation (NIV)	267 (56)
2. Mild to moderate work of breathing (WOB)	122 (26)
Non-responders (N=166, 35%)	
1. Required higher level of respiratory support	131 (28)
2. Transferred to CCU	7 (2)
3. Intolerance/agitation	4 (0.8)
4. Cardiac arrest	3 (0.6)

Discussion & Future Directions

Discussion: Current themes noted is that children experiencing respiratory distress (n=50) have a strong response to the therapy, while those being treated for increased work of breathing (n=122) tend to escalate to higher levels of non-invasive ventilation or intubation. However, children admitted to the CCU (n=404) often have multiple comorbidities, including congenital heart defects, developmental, genetic, and respiratory conditions; it cannot yet be ascertained as to which indications for therapy are the most appropriate for HHFNC until further data analysis is completed. We hypothesize that the non-responders will have impaired vital signs (i.e. altered heart and respiratory rate) and/or impaired blood gas values (i.e. hypercarbia and hypoxemia), with the most common reason for non-response is the need for higher levels of respiratory support (n=131).

Future Directions: This study will create a strong foundation on the use of HHFNC at SickKids for larger prospective studies to further assess the efficacy, safety, and efficiency of HHFNC therapy.

References:

- (1) Mikalsen, et al. 2016, Scandinavian Journal of Trauma, Resuscitation, and Emergency Medicine. (2) Lee et al. 2013, Intensive Care Medicine. (3) Hutchings et al. 2015, Archives of Disease in Childhood. (4) Spentzas et al. 2009, Journal of Intensive Care Medicine. (5) Mayfield et al. 2014, The Cochrane Database of Systematic Reviews. (6) The Hospital for Sick Children (2015). *Heated High Flow Nasal Cannula Therapy*. Toronto, ON. (7) *Junior Optiflow Nasal Cannula* [Online Image]. Retrieved August 17, 2016 from <https://www.fphcare.ca/respiratory/infant-care/respiratory-care-continuum/>. Copyright 2016 by Fisher & Paykel Healthcare.

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